SCIENCE

NEW SERIES
VOL. LV, No. 1434

FRIDAY, JUNE 23, 1922

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $6.00

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

11 Liberty St., Utica, N. Y. Garrison, N. Y.
New York City: Grand Central Terminal

Annual Subscription, $6.00. Single Copies, 15 Cts.

Entered as second-class matter January 21, 1922, at the Post Office at Utica, N. Y., under the Act of March 3, 1879.

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RESEARCH INSTITUTES AND THEIR VALUE[1]

IN this restless, drifting world in which we now live, even intelligent people are not always appreciative of the fact that many if not most of the great intellectual achievements in various fields have been accomplished only when the thinker has been protected from the interruption and annoyance of passing events and permitted to work out his ideas somewhat apart from the general current of existence. In the Middle Ages, the alchemist, the philosopher or the mathematician retired to a garret or cellar and there achieved his purpose, and even to this day the idea that starvation and a garret are successful stimulants to scientific investigation clings persistently to the popular mind, together with so many of those superstitions by which humanity is still largely guided. Truth is that the thinking man in the middle ages was driven into a garret and often compelled to accept poverty because his thoughts or discoveries had no commercial value or popular interest, and, if published, sometimes led to controversies settled once for all by that unanswerable argument of authority, the fagot and the stake. The example of Servetus must surely have been a severe blow to hasty publication. One of the early masters of medicine, he died a martyr to his printed opinions at the early age of 42, his old friend, John Calvin, seeing to it, it is said, that the fire was well started.

But the time when important extensions of the boundaries of knowledge, especially in science, can be accomplished in garret or cellar with no material except brains, a little sealing wax, some wire and a few pieces of glass,

[1] An address delivered at the opening of the new laboratory building of the Collis P. Huntington Memorial Hospital, Harvard University, May 15, 1922.

which was about the equipment with which Faraday made some of his most valuable discoveries in electricity, has long since passed. Brains are still the chief essential, but modern science has gone in most of its phases beyond the stage of easy discovery of important principles. No clearer demonstration of the fallacy of the popular belief in the capacity of the man in the street to solve complex problems exists than the report of the Naval Consultation Board in which it is shown that of one hundred and ten thousand suggestions received only one in a thousand were even worth considering, and of this one hundred and ten only one was put into production. A few highly trained scientific men, on the other hand, made most of the useful discoveries. To-day scientific advance in most fields depends upon the use of equipment of great delicacy and precision, and unfortunately only too often of very high cost. The time calls, therefore, for the organization and classification of research problems and a higher degree of collaboration between scientists than has ever been had before, and it is characteristic of that vision which has so often been a quality of Harvard thought and action that we are gathered together to celebrate the opening of a laboratory devoted to investigation in a field of science but newly set aside, that of biophysics. The name is new, though the science itself is not. When the professor of anatomy in the University of Bologna first used frogs' legs as a galvanometer to reveal the presence of electric currents, he was studying biophysics, even if in a somewhat elementary form. In our own times this new field for research has been sequestered from the disciplines of biology and physics as a special region, possibly because the knowledge of the chemistry and the physics of the human body has reached a point in its advance at which there is a little slowing-up in the rate of important discovery. In such a dilemma a shrewd scientist does not keep up a frontal attack, but quickly shifts to a slightly different approach to the problem. Thus, by the combination of the technical methods of physics and of chemistry in the study of living matter there is promise of an ample yield of valuable knowledge within the next few years and of a material advance which may possibly again illuminate the purely physical and chemical methods of attack on the secrets of life and in consequence lead to still further achievements in those fundamental sciences. Illustrations of the fertilizing value of this method of shifting the line of approach can be culled from the lives of many successful investigators. Pasteur is said to have started early in his life on the study of tuberculosis, but to have dropped it quickly when he found that he could make no headway with the technique then in use. If he had persisted, his name would not be known to-day. Paul Ehrlich spent several years investigating the problem of cancer, but as soon as he found that progress was slow and far-reaching results were doubtful, he quickly shifted to the more profitable field of an attack on parasitic diseases by means of chemical compounds, and there achieved a great and deserved success.

As it is one of the marks of genius to overcome obstacles with the least possible waste of energy, so the fact that this special field of biophysics has been selected for a concentrated attack affords an admirable criterion for the intelligence of those controlling the funds for cancer research in Boston. The world will profit by the investigations which in the future will be made in this laboratory, for in contrast to the worker of the older days, who so often concealed the results of his studies in order that he might reap some benefit from them, the modern scientist gives freely and at once to the public everything he achieves. He does not conceal or patent a valuable discovery which would in any way relieve human suffering.

The true investigator's chief stimulus is the love for his science and ambition for his institute; and the responsibility imposed by the great opportunities at his disposal will be, if he is the right sort, one of the strongest forces in sustaining the arduous labor of research. This concentration of responsibility and the development of intellectual power and leadership as problem after problem is solved is an important factor in the success of a truly scientific institute, a factor the psychology of which has often been overlooked by those administrators who wish to impose the regulations of the machine shop in order to obtain quantity production in science.

Besides the direct way in which an institution like this, devoted to research in some phase of pure or applied science, benefits humanity, there is also an indirect influence, not so fully appreciated. This is the reflex effect upon the university as a whole, for only by the possession of such centers of intellectual concentration does the university become a university in fact rather than in name. Every great teaching institution should be surrounded by a constellation of independent institutes such as this, devoted to the amassing of pure knowledge, without a view necessarily to its future use or practicality and without the encumbrances to effective thought which go with administrative work of the teaching of large numbers of immature students. Our men of genius in the universities still do too much undergraduate instruction and teach the teachers too little. This is one of the great defects of the present scheme of education, in that it accentuates routine and overlooks the spirit. When a university possesses a genius he should be tenderly protected and cherished. The ragweed will outgrow the orchid, as has been proved a thousand times. Why sacrifice another orchid to the test? But in research institutions lies true freedom of thought in the university. While to the undergraduates we must temper somewhat the boldness of our theories, in the research laboratory everything must be free. No one can foresee in what direction investigation must proceed. No hampering politicians, as in some state institutions, should be allowed to control the direction and type of investigation to be done, their equipment for this function as regards the natural sciences being usually somewhat less than that possessed by our Great Commoner, who is making so brave and useless a fight against the dangerous theories of evolution.

Who in his wildest moments could have imagined that the classification and anatomical study of the fleas which infest lower animals could ever have been of use in the saving of human lives? Yet when the Oriental plague threatened this country, in the results of such studies was found the means of combatting the disease, the uncontrolled ravages of which can best be learned by a reading of that old classic of Daniel Defoe's, "A Journal of the Plague Year." When we realize that because of our knowledge of public health obtained by research on apparently unimportant matters the repetition of such a plague is now impossible, we must be grateful to some of those who have made heavy sacrifices in the cause of science.

A few institutions like this will answer most effectively the statement recently made in the daily press that the foot-ball coaches had done more for Harvard than all the professors would ever accomplish—and this of a university which can claim Agassiz, Lowell, Norton, Child, Gibbs, Shaler, Royce and William James as only a few among those who have passed on. To enumerate the names of the living who are still doing for Harvard what these men did would be an insult to the intelligence of my audience.

The new building which we are gathered to inspect shows in its very architecture the thoughtfulness of those who planned it—simple as every workshop should be, for that is all a laboratory is, a place for labor. It shows that the money which has been given has gone on the inside rather than on decoration. I look forward to a day when architects will sacrifice all their art for the practical in laboratory building, and reserve the demonstration of their skill for libraries, museums and other structures which may properly give room for the display of artistic qualities.

But the building is not important. An institution of this type is always, it has been well said, the lengthened shadow of a great man. Those who are to work in it are far more important than any physical structure. The name in itself gives promise of long and useful service, bearing as it will the title of a line of famous surgeons. The annual reports of the Harvard Cancer Commission show how much has already been achieved. There are few groups of investigators in any country who have produced with relatively small means so much of sane, cautious, solid research work in cancer, biology and physics as have those who in the past have worked in the Huntington, and who are now to enjoy greater facilities, and so may properly be expected to do more and more as the laboratory expands. For

expand it inevitably will. It is said that opportunity knocks but once at the door, but this is the opportunity of receivers, not of givers. To the latter there is no limit. If this building had been built and equipped five years ago, we might not have had to share with our great scientific rival on the continent the discovery of many capital facts concerning the X-ray, for it was only the lack of equipment which kept the brilliant group of physicists who, under the leadership of Professor Duane, have made so many important advances in the theoretical study of X-rays, from covering many of the practical phases developed instead by our continental colleagues. The verification of the quantum relationship between the frequency of the X-ray and the voltage applied to the tube, as demonstrated by Duane, Hull and Webster, is a shining achievement which might easily satisfy any university for a long period of time. The work of Tyzzer on animal tumors especially laid the foundation for much recent research, while the demonstration by Bovie of the relationship between certain light rays and the coagulation of protein and the killing of cells is also a most important contribution to the newer aspects of biophysics. Whether the problem of cancer—that last great and as yet unanswered question in medicine—will be solved here, no one can say. But I am sure that the attack will be a brave one and that the results will be characterized by the same scientific caution and freedom from attempt at dramatic effect that have marked the work of the Harvard Cancer Commission in the past. We all look to this laboratory as the source of the highest type of scientific investigation combined with an unusual amount of common sense on the human side, due obviously to the influence of the director, Dr. Greenough. There is no reason to think that with the passing of time there will be any change in this high standard.

Let us all hope then that this building and its equipment and staff represent merely a beginning from which research will go forward on a broader and broader scale, until at some future time we may have a better insight than at present into what has hitherto successfully evaded human inquiry—the nature of life and growth. When that goal is achieved the solution of the cancer problem will be in sight.

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THE EFFECT OF THE NATURE OF THE DIET ON THE DIGESTIBILITY OF BUTTER

IT is estimated that in the United States about 18 pounds of dairy butter are consumed per capita yearly and of this amount the larger portion is used for table purposes. This indicates quite conclusively that in spite of the increasing variety of fats available for table and culinary purposes, dairy butter still remains one of the most popular and widely used edible fats. Formerly it was very generally believed that the principal if not the entire food value of butter was due to the energy which it supplied to the diet. The recent discovery that dairy butter contains a relatively large amount of vitamin A, which has been shown to be essential for an adequate diet, has served to further increase the popularity of this extensively used fat.

The very general use of butter for food purposes is no doubt responsible for the early and continued attention that has been given to a study of its nutritive value by physiological chemists and nutrition experts. Many digestion experiments have been carried on both in this country and in Europe to determine its digestibility, but since the experimental procedures of the different investigators were not uniform the results obtained do not permit of direct comparison. The lack of uniformity in experimental conditions is perhaps most noticeable in the wide variation of the nature of the basal ration used by the different investigators. However, this variation in the nature of the foods comprising the experimental diets permits to some extent a comparison of the effect

NOTE: Since dairy butter is a common constituent of nearly all diets the following résumé of digestion experiments, conducted by the author while employed as nutrition expert at the U. S. Dept. of Agri., is given to supply information concerning the effect of other food materials on the digestibility of butter.

of the nature of the diet on the digestibility of butter. Rubner, in a lengthy series of experiments, reports three different values for the digestibility of butter—for a simple diet of butter and potatoes[1] 96.3 per cent., for a diet of green beans and butter[2] 91.5 per cent., and for the latter diet with a larger portion of butter[3] 97.3 per cent.

Malfatti studied a diet of polenta (a porridge of Indian corn meal) and butter and found that butter was 97.7 per cent. digested.[4] Mayer determined the digestibility of butter[5] eaten as a part of a simple diet and reports 98 per cent. and 97 per cent. respectively as an average of three periods of three days each with a mature subject and a nine year old boy. Atwater conducted digestion experiments on a diet of fish and butter and found the butter[6] to be 91 per cent. digested. Huldgren and Landergren, who served as their own subjects, found the digestibility of butter,[7] eaten in conjunction with hard rye bread, was 95.4 per cent. Luhrig studied the digestibility of butter[8] served with a basal ration of meal, bread and vegetables and reports a digestibility of 96 per cent. for butter. Von Gerlach determined the digestibility of butter[9] when it was eaten with a basal ration of rice, zweiback and oatmeal and found it to be 97 per cent. digested. Since in the metabolism experiments noted above that are not uniform there are many factors, such as food, habits, occupations, and races of people employed as subjects, it is unwise to attempt to generalize to any extent on the effect of the nature of the diet on the digestibility of butter.

However, in view of the very general and wide spread use of dairy butter in conjunction with many kinds of food materials, it appears of interest to summarize briefly a number of digestion experiments in which butter has been included as a part of the experimental ration and which have been conducted under identical experimental conditions, as regards the type of subjects, the length of experimental period, and methods of chemical analysis. In many of the digestion experiments conducted by the writer to determine the digestibility of cereals, legumes, meats, vegetables and flours, butter has been employed as a source of fat for the experimental diet. The butter included in the experimental rations was uniform in that it was always obtained from the same source. Since the digestion experiments considered here were made during a period of four or five years, no attempt was made to use a single lot of butter for the entire series of experiments, but it is believed that this butter obtained from a single creamery and presumably from a constant source of milk supply was typical of the ordinary commercial butter purchased by the average consumer.

The table on p. 662 contains the data essential for the consideration of these experiments and the text which follows includes a discussion of the details of the different types of diets.

The first group of experiments referred to in the table, eight in which dairy butter was the food material studied, are discussed in detail in the initial paper[10] of a series which has appeared from time to time reporting the results of digestion experiments conducted to determine the digestibility of a large number of edible fats and oils. To secure data concerning the relative digestibility of edible fats and oils several digestion experiments with each of the fats studied were conducted under uniform conditions. The experimental ration consisted of commercial wheat biscuit, fruit, sugar, tea or coffee and a special cornstarch pudding or blancmange in which was incorporated the fat under consideration. In order to mask any noticeable flavor or odor of the fats studied, the blancmange was heavily flavored with caramel which gave a uniform characteristic caramel flavor and odor to all the

[1] *Ztschr. Biol.*, 15 (1879), No. 1, pp. 136-147.
[2] *Idem.*, 16 (1880), No. 1, p. 127.
[3] *Idem.*, 15 (1879), No. 1, pp. 174-176.
[4] Sitzber, K., *Akad. Wiss. (Vienna) Math. Naturw. Kl.*, 90 (1884), III, No. 5, pp. 328-335.
[5] *Landw. Vers. Stat.* 29 (1883), pp. 215-232.
[6] *Ztschr. Biol.*, 24 (1887), No. 1, p. 16.
[7] *Skand. Arch. Physiol.*, 2 (1890), No. 4-5, pp. 373-393.
[8] *Ztschr. Untersuch. Nahr. u. Genussmtl.*, 2 (1899), No. 6, pp. 484-506.
[9] *Ztschr, Phys. u. Diätet: Ther.* 12 (1908.9), No. 2, pp. 102-110.
[10] "Digestibility of Some Animal Fats," *U. S. Dept. Agri. Bul.*, 310 (1915), pp. 22.

Summary of Digestion Experiments in which Dairy Butter has been included in a Variety of Experimental Diets

Number of experiments	Nature of food material studied	Amount of fat eaten per subject daily, grams	Per cent. of butter in total fat consumed	Digestibility of entire ration		
				Protein per cent.	Fat per cent.	Carbohydrate per cent.
8	Butter	100	98	70.5	97.0	96.4
10	Dasheen	127	99	80.8	96.1	97.6
7	Soy-bean press-cake	92	62	86.6	94.2	96.3
4	Peanut press-cake	117	46	90.4	96.5	97.2
3	Kafir	67	99	49.5	91.6	97.0
4	Feterita	59	94	49.9	92.3	98.2
4	Milo	72	88	36.3	92.1	97.5
5	Kaoliang	76	89	13.3	90.2	97.0
5	Fine wheat bran	134	67	52.6	94.6	82.7
6	Unground wheat bran	107	65	39.9	93.7	84.4
7	Hard Palates	127	78	87.3	94.6	97.6

experimental diets which included edible fats and oils. Eight tests were made with this type of diet to determine the digestibility of butter and it was found that on an average butter was 97 per cent. absorbed by the body.

The studies of the food value and culinary possibilities of the dasheen, a variety of the taro (*Colocasia esculenta*), which is a staple constituent of the diet in large areas of the tropical countries, included a number of digestion experiments.[11] Since the advisability of the introduction of the dasheen into the subtropical regions of the country where the white potato can not be successfully grown or stored was under consideration, it was of considerable importance to have data concerning its digestibility. The basal diet for the digestion experiments with dasheen consisted of milk, which supplied the larger portion of the protein of the diet, fruit, and butter, which, with the fat from the milk, supplied the fat of the diet. The carbohydrate portion of the diet was largely derived from the dasheen. The results of these experiments show butter to be 96 per cent. digested when eaten as a part of a diet in which the carbohydrates were largely starch, derived from a starchy vegetable.

During the World War when it became necessary to conserve all resources to the utmost, the writer became intensely interested in promoting the use of the soy-bean and peanut press-cakes for human food. The expression of oil, under sanitary conditions, by the "cold process" from sound, clean soy-beans or peanuts produces a virgin oil and a high grade press-cake rich in protein. These legume proteins glycinin (soy-bean) and arachin (peanut) yield on hydrolysis a large amount of lysine, the amino acid essential for growth. The reported results of the chemical and biological examination of soy-bean and peanut proteins demonstrate beyond a doubt their high nutritional value. In order to supplement this data with information concerning the digestibility of these proteins, digestion experiments[12] were conducted in which the soy-bean and peanut press-cake flour combined with wheat flours was served in the form of biscuits. The experimental diet consisted of biscuits, fruit, butter, sugar and tea or coffee. Butter was served as a spread for the biscuits and lard was used as "shortening" in their preparation, accordingly the values reported for digestibility apply to the total fat of the diet rather than to either individual fat, but as both butter[13] and lard[13] have been reported as being 97 per cent. digested, it is of interest to note the effect of the soy-bean and peanut flour diets on their digestibility. Since butter constituted a half or more of the total fat of the experimental diets and since the reported digestibility for the total fat of the diets was for the soy-bean experiments 94 per cent., and

[11] "The Digestibility of the Dasheen," *U. S. Dept. Agri. Bul.*, 612 (1917), pp. 11.

[12] "Digestibility of Protein Supplied by Soy-bean and Peanut Press-cake Flours," *U. S. Dept. Agri. Bul.*, 717 (1918), pp. 28.

[13] "Digestibility of Some Animal Fats," *U. S. Dept. Agri. Bul.*, 310 (1915), pp. 22.

for the peanut experiments 97 per cent., it is evident that the digestibility of butter was lowered little if any by the other constituents of this type of diet.

From the results of the many attempts that have been made to find cereals suited for cultivation in the semiarid regions of this country it appears that the so-called non-saccharine grain sorghums are best adapted for the purpose. While these cereals are extensively included in the dietary of India, China, Abyssinia and South Africa, there is little recorded data relative to their digestibility. Accordingly digestion experiments were made to secure information concerning their value for human nutrition. Of the many non-saccharine grain sorghums which may be grown in the semiarid regions four, Dwarf Kafir, Feterita, Milo and Kaoliang, were chosen as typical. To determine the effect of cooking, etc., upon digestibility, experiments with the non-saccharine sorghums prepared in a variety of forms have been made by the writer but for the discussion here only those in which the sorghums were cooked and served as a mush will be considered since in these diets butter constituted practically the entire fat content of the diet. In this type of digestion experiments[14] with the grain sorghums the diet consisted of the cereal cooked as mush, apple sauce, butter, sirup, sugar and tea or coffee if desired. As may be noted from the above table the results of the digestion experiments with the non-saccharine sorghums show that their proteins are very incompletely absorbed by the body, due probably to the proteins being inclosed in the very tough cellular structure of the cereal. This coarse, rough, cellulose also may increase peristalsis to such an extent that the diet passes more rapidly than normal through the alimentary tract. If this theory is tenable it may also explain the lowered digestibility of butter, which was for the kafir experiments 92 per cent., for those with feterita 92 per cent., for those with milo 92 per cent., and for those with kaoliang 90 per cent.

For a long time considerable attention has been given to the desirability of including or excluding wheat bran in milling wheat flours. Inasmuch as the annual per capita consumption of wheat[15] is approximately five bushels this question assumes considerable importance, and among the factors to be considered in arriving at an intelligent solution of the problem is the extent to which the bran is digested by the human body. To obtain data in this connection a number of digestion experiments were made with coarse unground wheat bran and bran which had been ground to resemble flour in fineness. In these experiments[16] the bran was incorporated in a gingerbread and served in conjunction with potato, fruit, butter, sugar, and tea or coffee. As in the soy-bean and peanut flour experiments, lard was used as "shortening" in preparing the gingerbread and butter was served as a spread for the bread. Hence the values reported for the digestibility of fat refer to total fat of the diet. However, since a large portion of the total fat consumed was butter and since in the fine wheat bran experiments the total fat was 95 per cent. digested and in the unground bran experiments it was 94 per cent. digested, it is evident that for practical dietetics this type of diet did not lower the digestibility of butter.

According to reports[17] the large packing houses use the "hard palates" of cattle, which are taken from the roof of the mouth of beef animals, in the manufacture of potted meats and sausage in amounts varying from 2,500 lbs. to 6,000 lbs. monthly. Since chemical analysis showed that hard palates contain approximately 20 per cent. of protein it was decided to determine to what extent this protein was digested by the human body and seven digestion experiments[18] were made in which the ration consisted of potato, crackers, butter,

[14] "Studies on the Digestibility of the Grain Sorghums," *U. S. Dept. Agri. Bul.*, 470 (1916), pp. 30.

[15] *U. S. Dept. Agri. Bur. Crop Estimates Rept.*, 3 (1917), No. 10, pp. 99.

[16] "Experiments on the Digestibility of Wheat Bran in a Diet without Wheat Flour," *U. S. Dept. Agri. Bul.*, 751 (1919), pp. 20.

[17] "Digestibility of Certain Miscellaneous Animal Fats," *U. S. Dept. Agri. Bul.*, 613 (1919), p. 8.

[18] "Digestibility of Hard Palates of Cattle," *Jour. Agri. Research*, 6 (1916), No. 17, pp. 641-648.

sugar, tea or coffee and the hard palates served in the form of meat loaf. Butter was used in the preparation of the meat loaf and it was also served as a spread for the potatoes and crackers. From the results of the digestion experiments with the hard palate it was found that the total fat of the diet was 94.6 per cent. digested. Since the greater portion of the fat consumed was butter this figure is virtually that for the butter included in a protein rich diet—an average of 131 grams of protein was ingested daily by men employed at sedentary occupations. This should be sufficient indication that butter is very completely absorbed when eaten in conjunction with a high protein diet of this character.

SUMMARY

From the foregoing results of numerous digestion experiments it is evident that dairy butter is very completely utilized by the human body. In those diets in which the accessory foods were very nearly if not entirely absorbed by the human body, butter was found to be practically completed digested. When coarser materials, particularly those which provided considerable refuse, were included in the diet it was found that butter was somewhat less completely absorbed by the body. The general conclusion to be drawn from the results of the digestion experiments cited above is that butter eaten in conjunction with ordinary food materials is very completely digested and that for the diets studied, the nature of the diet does not produce a marked difference in the amount of butter absorbed by the human body.

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ARE SCIENTISTS ENCOURAGING POPULAR IGNORANCE?

I HEARTILY agree with the view of Mr. Halsey that readers of SCIENCE should become familiar with the anti-metric case as presented in the recent report of the National Industrial Conference Board, The Century Company, $2.00. This report gives the pro-metric argument as well as the anti-metric argument and is, therefore, signed by the metric members of the committee, but not as Mr. Halsey states, "because they could not do otherwise." Scientists do not need to be told the pro-metric argument, but they should know the character of the arguments advanced by the so-called American Institute of Weights and Measures against the metric system, Mr. Halsey being their paid commissioner. Beyond quoting them at length no comment of mine is necessary.

> For years . . . . the minds of children have been trained to believe in it (the metric system) as the only scientific system certain to become universal. Children leave school imbued with the metric fallacy. . . . Editors of newspapers knowing practically nothing about the subject have aped the schools and colleges, taught the fallacy and increased the ignorance. In the encouragement of the popular ignorance lies the chief danger to our established standards. p. 193.

> Advocates of the English system deny most emphatically that there is any demand worth serious consideration in favor of a change to the metric system in the United States. The deductions drawn from lists of names presented by the metric advocates . . . are wholly fallacious and misleading. . . . If this is the best the pro-metrics can show, only 60,000 to 80,000 people in the United States out of a population of one hundred millions—less than one tenth of one per cent. of the whole—favor a change. Such a demand . . . could be accounted for by the scientific group in this country, which comprises about this proportion of the population and is known to advocate the metric system. . . . The propaganda in favor of the metric system has emanated from one or two propaganda organizations working for the purpose, which have spread broadcast throughout the United States literature of an essentially misleading character. . . . The prominent individuals most frequently quoted as favoring the metric cause are not industrialists and business men, but such professional men as teachers, doctors, inventors and others who are interested chiefly in the scientific aspects of the question and have nothing of material value at stake or have espoused the cause as fallaciously represented by metric propagandists without having given due consideration to the practical side of the issue. p. 192.

We note that the American Association for the Advancement of Science, the American

Chemical Society, etc., have repeatedly passed strong resolutions in favor of the metric system and if we have been duped it is time to know it, because scientific men and teachers do have something at stake in the prosperity of America. We should be informed as to who these propagandists are who are spreading ignorance, what their motive is, and convincing evidence should be given and not merely dogmatic affirmations.

Practically all the real sentiment in favor of a change . . . comes from teachers, scientists, some engineers and from a few manufacturers making refined instruments or other articles requiring a minuteness of measurement. p. 194. Science stands in a unique position. Its methods are ever changing and are easily changed. . . The number of persons and interests involved in the field of scientific activity are small compared with those involved in other fields. For these reasons, . . . the usefulness of parts of the metric system in scientific work and in fine instrument making can not be taken as an indication of the advisability of adopting it gradually in the United States. p. 145. In fact, it is the so-called 'absolute' or centimeter-gram-second (C. G. S.) system rather than the metric system which is actually employed in scientific work. p. 145. In engineering practice it is, as in scientific work, a mixture of other units that is used and has been found of advantage in some connections rather than the metric system exclusively. This is demonstrated in electrical engineering . . . where a 'mongrel system' comprising the C. G. S. or absolute system, the metric system with the centimeter instead of the millimeter as a unit, and English feet, inches and square inches, is used. The units of electrical measurement, the ohm, ampere, volt and others . . . are not intrinsically more metric than English. p. 147.

Whether the absolute system bears the stigma of a "mongrel" system because of the use of the centimeter instead of the millimeter or because of the character of the gravitation constant or because there are 60 seconds in the minute is not clear, but it is hardly an argument against the adoption of the metric system in any case.

English measures and weights are no haphazard modern invention, but have come down to us from prehistoric times. p. 4.

This will be news to many who have been led to suppose[1] that the English yard has been recently established on the basis of the standard meter, replicas of which are kept by the U. S. Bureau of Standards. But the report says:

In fact, the Anglo-Saxon measures of length down to the present have remained on the same basis as is given in the statute of Edward II (1324) where a statement in statutory form of what has since become the well-known rule that 'three barley corns round and dry make an inch, etc.' p. 5.

"The organic growth and selection of the fittest units in the English system make it infinitely better adapted to different uses than the metric system. p. 138. In short, from every angle, the metric system is devoid of the English system's handiness and convenience; its units are either too large or too small for general everyday requirements. . . . The character and names of its units are so tied in with every-day experience that they are readily learned and retained; and the features just mentioned make the English system, as compared with the rigid and inflexible metric system, much more comprehendible to the average mind, and more convenient, adaptable, and comprehensive in filling the needs a system of weights and measures is called upon to fill. p. 140.

The current extensive use of decimals in connection with English units in modern calculations has made the work of computations in that system as easy as in the metric system. The rapid development and extensive use of calculating machines, slide-rules, etc., has . . . enabled computations of whatever kind to be made with equal ease in any system, so that the metric and English systems have in present practice been put on the same footing in this regard. . . . Supporters of the English system deny that there would be any saving of time through the more general use of the metric system in the schools. p. 143.

[1] U. S. Bureau of Standards Bulletin 1, 380 (1905).

"History of Standard Weights and Measures of the United States," by L. A. Fischer.

The United States yard and the British imperial yard were found to differ in length by one ten-thousandth of an inch, but the imperial yard differs in length from its authentic copies by amounts which are at least as great as this. Consequently, it was hopeless to obtain the exact length of the yard and on April 5, 1893, the meter was taken as the standard unit of length for the English system in the United States and containing exactly 39.37 inches.

The same argument in England is made in regard to English money.

> The English system . . . has been found acceptable to the great majority of the Latin-American importers and the imports into these countries consist in preponderant degree of manufactured products into which the English system of weights and measures is definitely incorporated,'' in spite of those countries being metric. p. 158. ''Of the millions of dollars worth of machine tools which . . . have (been) sold to France and Germany, the great majority have been sold without request or suggestion that any of the dimensions be made in accordance with the metric system. p. 159.
>
> It would be impossible gradually to substitute new metric standards and equipment for the old as the latter wore out without catastrophic confusion to industrial processes through a protracted period. Even if the change were made suddenly, . . . a long transition period fraught with confusion and disorder would inevitably follow. p. 175.

The proposal actually made by scientists that as far as possible metric designations be used for our existing English standards the report dismisses briefly by saying that it

> is impractical and in any event would be quite pointless because it could hardly be considered an adoption of the metric system. p. 175.

Of the well-known case of the Baldwin Locomotive Works building locomotives for Russia purely on metric specifications without changing their equipment, or working force or suffering any inconvenience or delay, the report says:

> If we continue to make equipment to existing standards and merely apply metric designations as was done in the case of the 'metric' locomotives built by the Baldwin Locomotive Works, this would be neither the adoption nor the use of the metric system. It would merely be expressing in terms of the metric system, with which the English is incommensurable, an existing standard dimension which is integral and exact in the English system. Such a change, it is held, besides being quite meaningless, would, if feasible, simply introduce confusion and error through calling things by wrong names. p. 176.

So the report proceeds to tell all of the dire calamities that will certainly befall us when the befuddled teachers and scientists have their way over the practical every-day business man.

> No possible advantages could result from a change to the metric system, but on the contrary, through such a change Great Britain and the United States would lose the vast trade they now possess with non-metric countries and with respect to metric trade they would surrender their advantages to such metric countries as France and Germany. p. 160.

In spite of Mr. Halsey's statement given above that products incorporating the English system can be used in countries which have adopted the metric system, it appears that if we adopted the metric system *we* could not do the same.

> Some conceptions of the difficulties which would be involved in such a destruction of standards is given in the following: . . . All rules, tables, formulæ, used in calculations involving measures of length. All drawings of manufactured articles. All measuring scales and measuring tools, calipers, verniers, etc. . . . All machine tools, leading screws of lathes, . . . locomotives, cars, railroads, and their appurtenances, all marine and stationary engines, all ships. p. 177. We can not regard the use of both systems on the same machine as a thing to be tolerated, much less deliberately encouraged. p. 179.
>
> The man who can estimate or indicate in words the value of mechanical standards to this country does not live. The cost of attempting to change air-brake hose couplings is not represented by the value of the tools for making the couplings in the Westinghouse Works, but by the infinite confusion of the railroads in getting from one standard to another. p. 187.

Finally the report attempts to show that whereas every civilized country except Great Britain and the United States is metric, this is only nominally the case.

> The statement that the countries named (France, Germany, Norway, Sweden, Belgium, Switzerland, Italy, Japan, the Central and South American countries, etc., and the Latin acquisitions of the United States) customarily employ the metric system is a pure assumption. No evidence of this is submitted, while, on the contrary, all available evidence shows that in some of these countries the system is used but little, and in none of them is it universal. p. 168.

Hence the report suggests

> that a conference of Great Britain, the United States and other countries be called to study carefully all natural systems of weights and measures

with a view to a more complete standardization of the inch and the foot the world over and to draft legislation . . . legalizing it in various countries as a world standard along with, if not superseding the metric system. p. 211.

The reader is referred to the report to see that the true spirit of the argument of the report has been preserved and also to get the pro-metric side.

Such a tissue of deliberate misrepresentation needs merely to be presented to scientific men for its refutation line upon line. Were it true that American scientists and teachers are spreading ignorance, this report would deserve to be a "best seller." But the challenge which it contains should not go unmet. The Council of the American Chemical Society at its recent meeting voted to ask the various scientific, educational, engineering, medical and pharmaceutical societies to send representatives to the Pittsburgh meeting of the society in September to consider what further steps can be taken toward the gradual introduction of the metric system. Here is an opportunity to answer the challenge.

The best answer to Mr. Halsey's contention that it can not be done is that *it is being done.* There has just come to hand the current schedule of chemicals of the national government, which is class 4, which has practically all pure chemicals listed in metric units only. Henceforth all pure chemicals appearing on the general schedule of supplies will be listed and purchased entirely in the metric system for the sixteen bureaus of the government.

In a volume which has just come from the press entitled *Metric System for Engineers,* written by Charles B. Clapham, a London engineer, the author gives an unbiased answer to many of the anti-metric arguments. For example, he says:

All the metric screws likely to be required can be cut on the usual English and American lathes, well within the accuracy required for manufacturing purposes, if *one additional change wheel* is provided. p. 33.

He says significantly, p. 148:

In considering the cost and inconvenience aspect, it is to be feared that many false objections have been put forward; etc.

He notes that a hundredweight contains 112 pounds, that a "stone" if used in weighing potatoes consists of 14 pounds, but when weighing butcher's meat contains only 8 pounds! This is far surpassed, however, by the complexity of the United States bushel. The use of the metric system is steadily growing, every school-boy talking of wave-lengths in hundreds of meters. Much further information on metric progress is given in an excellent work on *World Metric Standardization* published by the World Metric Standardization Council of San Francisco.

The *Valve World* for May, 1922, states:

More than 215 member organizations of the Chamber of Commerce of the United States have gone on record in favor of gradual metric standardization. More than 15,000 manufacturers and engineers have petitioned Congress to enact metric standards legislation, and these represent concerns capitalized at several billions of dollars. The states of Maine, Connecticut, New Hampshire, Utah, Illinois, California, North Dakota and Tennessee have officially memorialized Congress to adopt the metric system as the sole system of weighing and measuring for the benefit of all the people of the United States.

One is reminded of an old couple up in Vermont who went to town; and, passing a shop window, Lucy remarked, "George, why don't you buy a new hat in place of that disgraceful old thing?" To which George replied without going inside to inquire the price of the hat he saw, "I can't afford it. I'd have to get used to a new one. Besides I like the old one and I couldn't wear two."

EUGENE C. BINGHAM

AMERICAN COMMITTEE TO AID RUSSIAN SCIENTISTS WITH SCIENTIFIC LITERATURE

RUSSIAN scientists have been almost completely cut off from access to western European and American literature since 1914. This isolation, coupled with great physical hardships, is naturally interfering with the progress of their work, although it has by no means entirely put a stop to it.

Through many sources appeals are coming from Russian botanists, zoologists, chemists,

physicists, geologists, engineers and others for the recent literature in their respective fields. The craving of these men for contact with the rest of the scientific world is very great. At various times scientific groups in this country have suggested the desirability of sending literature from this country to Russian scientists.

These suggestions have now resulted in the formation of an American Committee to Aid Russian Scientists with scientific literature. The committee has arranged with the American Relief Administration, of which Mr. Herbert Hoover is chairman, to receive the literature collected by the committee and assume the entire care and cost of its overseas transportation and delivery to the distributing agency in Moscow.

The literature will be distributed in Russia among the universities, scientific societies and individual scientific investigators by a special committee representing the Academy of Sciences and other recognized Russian scientific organizations in cooperation with the American Relief Administration which has representatives in Moscow, Petrograd, Kiev, Kharkov, Kazan and other university and academic centers.

The American Committee to Aid Russian Scientists is a voluntary and temporary organization of scientific men. Its activities will continue only until the regular channels for the shipment of scientific literature to Russia are reopened. It has no funds for the purchase of scientific books or scientific periodicals. It must appeal, therefore, to the generosity of the scientific societies of America, government and state scientific bureaus, individual scientists and publishers of scientific books.

The committee desires chiefly to obtain scientific books, scientific periodicals, authors' reprints, publications of government and state scientific bureaus, scientific institutions and university presses which are of an original scientific character or contain technical information, and which have appeared since 1914.

There is in Russia a fairly large number of scientific institutions. It is out of the question at the present time to undertake to supply adequately all those institutions with literature, but the committee hopes to provide at least six copies of each publication, since it feels that this number may meet at least the more urgent needs of the Russian centers of scientific endeavor at Moscow, Petrograd, Kazan, Kiev, Odessa and a few other principal university cities. If more than six copies can be spared, so much the better. On the other hand, if this number should be burdensome, a smaller number of copies will be of service.

The committee has at its disposal only a limited fund to cover the necessary clerical work. It will, therefore, appreciate it if the contributors of literature will cover the cost of its transportation to New York, from which point all cost of handling and shipment will be borne by the American Relief Administration.

The committee hopes that the response to this request will be whole-hearted and universal. The assistance that American scientists can give to the Russian scientists who are in distress, besides being a good Samaritan act, will be a real contribution to the progress of science. It may also be the means of re-establishing the normal exchange of scientific results between the Russian and American scientists, and will be a fine manifestation of the cooperation of men in science throughout the world.

Contributors should send, in triplicate, with each consignment a list of the publications forwarded by them. These lists, together with all letters containing advices of shipments, express and shipping receipts, should be addressed to the American Relief Administration, Russian Scientific Aid, 42 Broadway, New York, N. Y.

The publications themselves should be sent by express, or, if very heavy, by freight, to the American Relief Administration, care of Gertzen Company, 138 Jane Street, New York, N. Y.

Requests for further information should be sent to the American Committee to Aid Russian Scientists, 1701 Massachusetts Avenue, Washington, D. C.

VERNON KELLOGG,
Chairman
L. O. HOWARD,
DAVID WHITE,
RAPHAEL ZON,
American Committee to Aid Russian Scientists with Scientific Literature

SCIENTIFIC EVENTS

THE AGITATION AGAINST THE TEACHING OF EVOLUTION

PROFESSOR J. V. DENNEY, president of the American Association of University Professors, addressed on June 14 the following letter to the moderator of the conference of the Northern Baptist churches meeting in Indianapolis:

As president of the American Association of University Professors, I desire to call attention to the peril confronting our higher institutions of learning at the present time because of the "Fundamentalist" or "anti-evolution" movement which has appeared in two state legislatures and in the constituencies of several colleges controlled by or affiliated with the religious denominations.

Letters from presidents and professors indicate widespread anxiety lest the cause of higher education suffer serious injury through attempts at coercive measures, interfering with the professor's duty to teach the truth of his subject as determined by the body of past and present laborers in his own field and as confirmed by his own conscientious studies and researches. The chief injury is not merely to the professor who loses his position or to the particular institution that sacrifices a permanent aim to a passing fear. It is in the degradation of the office of teacher; in the establishment of distrust and suspicion in the public mind towards all colleges and universities; and in the immediate loss to both church and state of strong forces for good through the slackening of devotion and enthusiasm and the encouragement of casuistry, subtlety and insincerity among those who are called to teach with an eye single to truth.

The colleges controlled by or affiliated with religious bodies are public institutions in the sense that they solicit and receive students on terms common to all good colleges. They impose on applicants no political or religious tests. They forewarn the public of no doctrine in history, economics, literature and the sciences that is essentially at variance with the body of free and accepted teaching in these departments of learning throughout the country. Their professors cooperate in the work of all of the learned societies, and are bound by the code of honor in scientific research and by the obligation of scrupulous honesty of statement in teaching. Any invasion of this high obligation is an attack on manhood in teaching and destructive to real education.

Any college or university, whatever its foundation, that openly or secretly imposes unusual restrictions upon the dissemination of verified knowledge in any subject that it professes to teach at all, or that discourages free discussion and the research for the truth among its professors and students will find itself shunned by professors who are competent and by students who are serious. It will lose the best of its own rightful constituency and will cease to fulfill its high ministry. The same results, disastrous to true education, will follow whether the restrictions are adopted voluntarily by the college itself, or are forced upon its administrative officers by the state legislature, an ecclesiastical body or by powerful influence operating through trustees. The question of legality and of good motive is also irrelevant so far as moral and educational results are concerned.

The five thousand members of the American Association of University Professors in active service in some two hundred colleges and universities of the United States are of one mind on the fundamental necessity of preserving the integrity of the teaching profession. They realize that their work is a sacred trust that can be fulfilled only in freedom of conscience, loyalty to the truth, and a profound sense of duty and of personal responsibility. They claim the support of all good Americans whatever their creed in resisting measures that will prove ruinous to our institutions of higher learning.

THE PROPOSED BOMBAY SCHOOL OF TROPICAL MEDICINE[1]

WE learn from India that the government of Bombay has declined to proceed with the project for establishing a School of Tropical Medicine at Bombay. The news is not a little surprising, for the government of Bombay had very definitely expressed its intention to establish the school, and Sir Dorab Tata had promised to contribute a lakh of rupees a year towards the expenditure which was to be incurred. The Bombay School of Tropical Medicine was to have been opened on April 1 last, and all arrangements were made for this purpose. It was only at the last moment that the Bombay government determined to cut out of the budget the whole sum allotted to the school, and issued orders that the scheme should not be proceeded with. In consequence Sir Dorab

[1] From the *British Medical Journal*.

Tata has withdrawn his offer, which was contingent on the government founding a school of tropical medicine at Bombay. As will be seen, matters had gone very far before the government of Bombay repudiated the undertaking it had given. They had gone even further than we have so far indicated, for rather more than a year ago the Royal Society was asked to select professors for the chairs of clinical medicine and therapy and of protozoology in the school. The Royal Society, acting through its Tropical Diseases Committee, issued advertisements widely—in this country, in the dominions and in America. From among the applicants it selected two, one for each chair. The protozoologist selected was an American, but he, we understand, subsequently, on private grounds, withdrew his acceptance. The successful applicant for the other chair, an Australian (Professor N. Hamilton Fairley), resigned his appointment in Australia to become Tata professor of clinical medicine in the Bombay School. The government of Bombay has now given him notice that it will dispense with his services on October 31. The situation thus brought about is obviously most unsatisfactory, and the matter can not be allowed to rest where it is. When the Royal Society acts for the Indian government and invites applications for positions on definite terms, the candidates selected assume that a written contract is superfluous. Clearly the Royal Society has been placed in a very false position. At the request of the government of India it undertook to select suitable persons to occupy the two chairs. With the authority of the government of Bombay the Royal Society, through its committee, issued advertisements inviting candidates to come forward and stating the terms and conditions of the appointment, which was to be in each case for a term of five years in the first instance, "but may be extended by the government." It is now left in the lurch by the government of Bombay, which professes to find that it has miscalculated its resources and is not in a financial position to carry out its bargain. The Royal Society will, we feel sure, have the support of public opinion in any action it may take, and the medical profession in particular will be anxious to see that justive is done to Professor Fairley, if not by the government of Bombay, then by the government of India, which can not absolve itself from responsibility for the acts of the provincial government. We understand that a new central research institute for India may shortly be established, probably at Delhi; this may afford the government of India a way out of the false position in which it has been placed by the government of Bombay.

THE ROYAL ACADEMY OF BELGIUM[1]

The Royal Academy of Belgium celebrated the one hundred and fiftieth anniversary of its foundation on May 23 and 24 in the presence of a large number of its members and of delegates from other academies and learned institutions. On the Wednesday afternoon, May 24, numerous congratulatory addresses were presented at the Palais des Académies, and the members and visitors were afterwards received at the Hôtel de Ville by the Mayor of Brussels, M. Adolf Max, and his aldermen, MM. Steens, Vande Meulebrouck and Coelst; a reception was held at the Palais des Académies in the evening, where an exhibition of medals and portraits connected with the history of the academy had been arranged. The anniversary celebration itself was held in the large hall of the academy on the afternoon of May 25 in the presence of the king, the minister of arts and science, M. Hubert, formerly rector of the University of Liége, Cardinal Mercier, and the English, French, Dutch, Spanish and Japanese ambassadors. The president, M. Vauthier, in an address of welcome, briefly sketched the history of the academy and its influence on the intellectual development of Belgium. The minister of justice, M. Masson, tendered the congratulations of the Belgian government, and Monseigneur Baudrillart spoke in the name of the Institut de France. Sir William B. Leishman, as vice-president of the Royal Society, represented the British universities and learned societies; he referred to the activities of Belgian bacteriologists and paid a high tribute to the work of M. Jules Bordet. MM. Lameere, Pirenne and Verlant, representing respectively

[1] From *Nature*.

the classes of science, of letters, and moral and political sciences and of fine arts, contributed summaries of the activities of their several sections of the academy. Later the visitors were received by the king and the queen at the Palace of Laeken, and in the evening a banquet was held at the Hôtel Astoria.

THE ROYAL GEOGRAPHICAL SOCIETY

AT the annual meeting of the Royal Geographical Society on May 29 Lord Ronaldshay was elected president of the society in succession to Sir Francis Younghusband, and the following were elected vice-presidents: Sir Francis Younghusband, Colonel Sir Charles Close, Mr. D. W. Freshfield, Lord Edward Gleichen, Sir T. H. Holdich, and Sir J. Scott Keltie.

The royal medals were presented, the founder's medal being awarded to Lieutenant Colonel C. K. Howard-Bury for his distinguished services in command of the Mount Everest Expedition, 1921, and the patrons' medal to Mr. Ernest de K. Leffingwell, Los Angeles, California, for his surveys and investigations on the coast of northern Alaska. Mr. Oliver B. Harriman, first secretary at the American embassy, on behalf of Mr. Leffingwell, who could not attend, accepted the patrons' medal.

The other awards of the council were made as follows: The Victoria medal to Mr. J. F. Baddeley, for work on the historical geography of Central Asia; the Murchison grant to Mr. Charles Camsell, deputy minister of mines, Canada, for explorations and surveys in northern Canada (accepted, on Mr. Camsell's behalf, by Mr. Peter Larkin, high commissioner for Canada); the Back grant to Khan Bahadur Sher Jang, for surveys on the Indian frontier and in adjacent countries; the Cuthbert Peek grant to Mr. F. H. Melland, for explorations in Northern Rhodesia; and the Gill Memorial to Mr. A. R. R. Boyce, of the Sudan Survey, for triangulations in the Sudan.

The address of the retiring president was chiefly concerned with the Mount Everest Expedition.

SIGMA XI AT UNIVERSITY OF KENTUCKY

THE thirty-seventh chapter of Sigma Xi to be known as the Kentucky Chapter was installed at the University of Kentucky on May 5. The petitioning group numbered seventeen. These were already active members of the society, having been elected to such while connected with other educational institutions.

The installation exercises were conducted by Dr. Henry B. Ward and Dr. Edward Ellery, president and secretary of the national organization. The charge to the chapter was delivered by Dr. Ellery and the symposium was conducted by Dr. Ward.

The following officers were elected:

President: Dr. Paul P. Boyd
Vice-president: Dr. W. D. Funkhouser.
Secretary: Professor E. S. Good.
Treasurer: Professor E. N. Fergus.

A banquet was held in the evening at the Phoenix Hotel, Lexington. The chapter had as its guests Dr. Ward, Dr. Ellery, Judge R. C. Stoll, chairman of the executive committee, University of Kentucky, Dr. Glanville Terrell, chairman of the Graduate School, Professor W. S. Anderson, president of the Research Club, Dr. Thomas B. McCartney, acting-president of Transylvania College, Dr. Robert C. Hinton, of Georgetown College, and Dr. Frank L. Rainey, of Center College.

Besides those of the Kentucky Chapter present at the banquet were the following members of the society resident in Lexington: Dr. A. F. Hemmingway, Dr. J. A. Gunton, Professor Mary Brown, Dr. J. A. Herring and Dr. Philip P. Blumenthal.

Dean P. P. Boyd acted as toastmaster and toasts were responded to by Judge Stoll, Dr. Ward, Dr. Ellery and Dr. McCartney.

DEAN OF THE SHEFFIELD SCIENTIFIC SCHOOL

THE Yale Corporation has elected as dean of the Sheffield Scientific School in succession to Director Russell H. Chittenden, Professor Charles Hyde Warren, since 1900 a member of the faculty of the Massachusetts Institute of Technology, where he has been professor of mineralogy since 1915.

The dean-elect of the Sheffield Scientific School served as an assistant in chemistry and mineralogy in that school from 1896 to 1900, studying in the Graduate School during this period and receiving the degree of doctor of

philosophy in 1899. In addition to his teaching at the Massachusetts Institute of Technology he has been extensively occupied with expert work for various mining and manufacturing chemical concerns. He also carried out a large quantity of research work of a purely scientific character.

Professor Warren is a member of the American Academy of Arts and Sciences and of the Geological Society of America. He is also a member of the Yale Chapter of the honorary society of Sigma Xi. His published works include "A Manual of Determinative Mineralogy" (1910), and contributions to American and German technical journals.

Dr. Russell H. Chittenden has been a member of the Yale faculty since his graduation from the Sheffield Scientific School forty-seven years ago. He has been head of the Sheffield Scientific School since 1898, when he succeeded Professor George Jarvis Brush, first director of the school. Dr. Chittenden offered his resignation to be effective a year ago, but conceded to a wish that he spend another year in office until a suitable successor might be found.

SCIENTIFIC NOTES AND NEWS

THE joint meeting of the American Association for the Advancement of Science and its Pacific Division is being held this week at Salt Lake City. The address of the president of the Pacific Division, Dr. Barton W. Evermann, given on Thursday evening, is on "The conservation and proper use of our natural resources." At the dinner on Friday evening, Professor James Harvey Robinson gives an address on "The humanizing of knowledge."

THE gold medal of the Linnean Society of London, which is given in alternative years to a botanist and a zoologist, was this year awarded to Professor E. B. Poulton at the anniversary meeting on May 24. In making the presentation, the president, Dr. A. Smith Woodward, referred to Professor Poulton's long labors in entomology, and his keepership of the Hope Collection at Oxford.

THE Charles P. Daly medal of the American Geographical Society for 1922 has been awarded to Lieutenant Colonel Sir Francis Younghusband, president of the Royal Geographical Society. It has been forwarded through the Department of State for presentation at London by the American ambassador. The medal bears the inscription: "Lieutenant Colonel Sir Francis Younghusband for explorations in northern India and Tibet and for geographical publications on Asiatic and African borders of the Empire."

RUTGERS COLLEGE has conferred the degree of doctor of science on Mr. Thomas A. Edison.

AT its annual commencement held on June 6, the University of Utah conferred the honorary degree of doctor of laws on James E. Talmage, who was formerly president of, and professor of geology in, the institution. On the same occasion the honorary degree of doctor of science was conferred on Dorsey Alfred Lyon, of the U. S. Bureau of Mines.

THE University of Maryland at its commencement on June 10 conferred the honorary degree of doctor of science upon Eugene Amandus Schwarz, honorary custodian of coleoptera in the U. S. National Museum. Mr. Schwarz began official work as a specialist in beetles for the Division of Entomology under the U. S. Commissioner of Agriculture in 1878.

AT the commencement of the University of Pittsburgh on June 14, the honorary degree of doctor of laws was conferred upon Mr. Alfred Cotton Bedford, chairman of the board of directors of the Standard Oil Company of New Jersey. This honor was bestowed upon Mr. Bedford in recognition of his activities in the development of the American petroleum industry and for his foresight in the encouragement of the application of scientific research.

PROFESSOR H. O. HOFMAN, professor of mining and metallurgy at the Massachusetts Institute of Technology, and Professor A. E. Burton, dean and professor of topographical engineering, have retired from active service.

PROFESSOR OAKES AMES has resigned as director of the Harvard Botanic Garden. It is expected that he will continue as assistant professor of botany at the Bussey Institution.

PROFESSOR E. KRAEPELIN has asked to be relieved from delivering the course on psychiatry at the University of Munich, as he wishes to devote all his energies to research on psychiatry

at the special institution for this purpose, which is practically his creation.

RECENT appointments to industrial fellowships in the Mellon Institute of Industrial Research of the University of Pittsburgh include the following: E. R. Clark, B.A. (Yale); H. E. Dierich, A.B. (Kansas); Marc Darrin, B.S. and M.S. (Washington); O. B. J. Fraser, B.S. (Queen's); A. W. Harvey, B.S. (Syracuse), M.S. and Ph.D (Pittsburgh); C. R. Texter, B.S. (Pennsylvania State); and B. B. Wescott, B.S. and M.S. (Pittsburgh).

ALEXANDER WEINSTEIN, Ph.D., now holding the Sigma Xi fellowship and working in the laboratory of Professor T. H. Morgan at Columbia University, has been appointed to a Johnston scholarship in the Johns Hopkins University.

DR. ALEŠ HRDLIČKA, curator of the Division of Anthropology of the Smithsonian Institution, has consented to serve the Children's Bureau of the United States Department of Labor in an advisory capacity on matters related to the field of anthropology.

PROFESSOR WILLIAM TRELEASE, of the department of botany in the University of Illinois, sailed for Europe on June 3, to complete an intensive study of certain plant groups. Professor Trelease will visit herbaria at Kew, Paris, Geneva, Berlin, Stockholm and Copenhagen.

DR. ALBERT JOHANNSEN, professor of petrology in the University of Chicago, will spend the summer in Europe, doing geological work and visiting various universities. He sailed from New York on June 21.

PROFESSOR OLAF P. JENKINS, of the State College of Washington, is to take charge of geological investigations of the coal of Whatcom and Skagit counties, Washington, for the State Division of Geology, Department of Conservation and Development.

HARLAN I. SMITH, archeologist of the Victoria Memorial Museum of Ottawa, is at Bella Coola, British Columbia, continuing his investigations into the material culture of the Bellacoola Indians.

DR. VERNON KELLOGG, permanent secretary of the National Research Council, gave the annual Phi Beta Kappa address at the University of Virginia on June 13.

ON June 7, Dr. D. S. Jordan delivered the commencement address to the University of Denver, Colorado, his subject being "The melting pot."

ON June 11, Dr. H. P. Nichols, rector of Holy Trinity Church, New York, delivered the baccalaureate address at the University of Colorado. He took as his subject "Evolution, and its highest product, man."

PROFESSOR ERNST FUCHS, of Vienna, gave a Mayo Foundation lecture at the Mayo Clinic June 9. His subject was "Syphilis and its relation to diseases of the eye." On June 1 Dr. H. Berglung, of the department of biochemistry, Harvard Medical School, lectured on "The chemistry of the nonprotein nitrogen of the blood."

ON June 16, Mr. Edward R. Weidlin, director of the Mellon Institute of Industrial Research of the University of Pittsburgh, addressed the fourth annual convention of the National Lime Association on "The value of research to industrial associations." This convention was held in Cleveland, Ohio.

A PUBLIC meeting of the British National Union of Scientific Workers was held at University College, London, on June 15, when an address was given by Mr. F. W. Sanderson, headmaster of Oundle, on "The duty and service of science in the new era." The chair was taken by Mr. H. G. Wells.

THE Yale Corporation has voted that the Botanical Garden shall be known as the Marsh Botanical Garden, in order that the memory of Othniel C. Marsh and of his generosity to the university may be more effectively perpetuated. Othniel C. Marsh was a graduate of Yale College in the class of 1860 who became the first professor of paleontology in the university. Professor Marsh died in 1899, bequeathing to the university his former residence, which has since been used as the School of Forestry. The Botanical Garden is connected with this school.

JAMES MCMAHON, emeritus professor of mathematics at Cornell University, died on June 1 at the age of sixty-six years.

Dr. Edward Hall Nichols, professor of clinical surgery in the Harvard Medical School, died on June 12, aged fifty-nine years.

Dr. W. H. R. Rivers, of the University of Cambridge, known for his work in anthropology and psychology, died on June 4, at fifty-eight years of age.

Nature notes that the first meeting of the "Institut International de Chimie Solvay" was held in Brussels on April 20-27, under the presidency of Sir William Pope. It will be remembered that before the war the late M. Ernest Solvay set aside a capital sum to be expended in the course of thirty years by the International Institute of Physics, and that meetings under the auspices of this institute have been held in Brussels both before and since the war. More recently M. Solvay set aside a further capital sum of one million francs, also to be expended in thirty years, for the promotion of the science of chemistry. The meetings of the institute are attended by delegates from different countries, the number being limited to about thirty, so that the discussions may be as free and as informal as possible. The recent meeting was devoted to the consideration of a number of those questions which affect the foundations of modern chemistry, and its program included the presentation of papers on isotopes, by Soddy, by Aston, and by Perrin and Urbain; on X-ray analysis and molecular structure, by W. H. Bragg; on the electronic theory of valency, by Mauguin; on optical activity, by Pope and by Lowry; and on chemical mobility, by Job.

The *Journal* of the American Medical Association, quoting from the *Preusa Medica*, describes the centennial of the foundation of the Academia Nacional de Medicinia at Buenos Aires, April 18. The rector of the university, Dr. José Arce, presided. The historical address was delivered by the president of the academy, Dr. Eliseo Canton. Among the announcements made was that of the institute of experimental medicine, the first of its kind to be founded in South America. A prize of a gold medal and $5,000 was awarded to Dr. P. Belou for his "Stereoscopic Atlas of the Anatomy of the Ear"; a silver medal and $3,000 to Dr. C. Lagos García for his work, "Human Sexual Malformations," and a copper medal and $2,000 to Dr. F. Garzón Maceda for his "Manual of Zoopharmacy." A work by Dr. P. P. Rojas on the structure of the myocardium received honorable mention. Three days were devoted to the centennial ceremonies.

Dr. R. S. McBride, scretary of the Gas and Fuel Section of the American Chemical Society, announces that the new section will meet with other sections of the society at the fall meeting to be held in Pittsburgh September 4 to 9. Among the topics to be discussed will be the general subject, "Combustion," in the form of a special symposium to be conducted under the chairmanship of Professor R. T. Haslem, of Massachusetts Institute of Technology. It will include a program of papers on chemical methods underlying fuel utilization. Officers of the section are: Dr. A. C. Fieldner, Bureau of Mines, Pittsburgh, *chairman,* and R. S. McBride, Colorado Building, Washington, D. C., *secretary.* Dr. McBride has requested that any members of the society having papers to present at the meeting of this section should forward them in full or in abstract form to the chairman or secretary or should notify these officers regarding their intention to prepare the papers.

The following resolution was passed by the faculty meeting of Kenyon College, on May 29: "Voted that the faculty deplores agitation against the explanation of natural phenomena known as the theory of evolution, and regards such propaganda as dangerous to scholarship, education and the progress of civilization."

A gift of £10,000 has been made to aid cancer research by Mr. and Mrs. G. F. Todman, of Sydney, N. S. W., in memory of their daughter. At the request of the donors Sir Joseph Hood, M.P., has allocated the sum as follows: £4,000 to the Imperial Cancer Research Fund, Queens Square, Bloomsbury; £1,000 each to the Middlesex Hospital, the Cancer Hospital, Fulham Road, London, the Christie Hospital, Manchester, the MacRobert Endowment, Aberdeen University, and the Cancer Hospital, Glasgow; and £500 each to the Radium Institutes of London and of Manchester.

UNIVERSITY AND EDUCATIONAL NOTES

ANNOUNCEMENT is made that the residue of the estate of the late Hamilton B. Tompkins, of New York City, left in his will to Hamilton College, amounts to $650,000.

THE salary endowment fund of Vassar College has reached the sum of $3,030,000.

A RESEARCH fellowship of $1,000 for the study of orthopedics in relation to hygiene and physical education will be offered by Wellesley College, beginning in September and continuing for one year.

DR. FRANK I. KERN, professor of botany, has been appointed dean of the newly established Graduate School of the Pennsylvania State College.

M. D. HERSEY, associate professor of physics, R. P. Bigelow, R. R. Lawrence and H. W. Shimer have been promoted to full professorships at the Massachusetts Institute of Technology. Dr. Bigelow will be professor of zoology and parasitology; Professor Lawrence is a member of the electrical engineering department; Dr. Shimer will be professor of paleontology.

DR. R. E. COKER, M.S. (North Carolina), Ph.D. (Johns Hopkins), head of the division of scientific inquiry of the U. S. Bureau of Fisheries, has been elected to a professorship of zoology in the University of North Carolina.

GEOGRAPHERS who received their doctorates at Chicago have recently been promoted as follows: To a professorship, Carl O. Sauer, at the University of Michigan. To associate professorships, Stephen S. Visher, at Indiana University; Wellington D. Jones and Charles C. Colby, at the University of Chicago. To assistant professorships, Robert S. Platt and Derwent S. Whittlesey, also at Chicago.

AT the University of Kansas, assistant professor Curt Rosenow has been promoted to an associate professorship in psychology and Dr. Hulsey Cason (Columbia, '22) has been appointed assistant professor of psychology.

DR. ELWOOD S. MOORE, dean of the School of Mines of the Pennsylvania State College, has resigned, to take charge of the work in economic geology at the University of Toronto.

DR. JOHN MACPHERSON, lately retired from the post of commissioner of the Board of Control for Scotland, has accepted for three years the professorship of psychiatry at the University of Sydney.

DISCUSSION AND CORRESPONDENCE

OBSERVATIONS OF FALLING METEORITES

TO THE EDITOR OF SCIENCE: The numerous recently reported occurrences of falling meteorites are so contradictory and so at variance with what reason would lead one to expect as to make one quite cynical concerning the value of human testimony.

Few natural phenomena, it may be stated by way of introduction, are more likely to unduly excite the imagination than those attendant upon a fall of meteorites. The suddenness, the unexpected nature of the occurrence, the light and noise, and perhaps above all the sensation of fear aroused when a solid body is suddenly projected from seemingly empty space, all have effect, and it is not surprising that accounts are widely variable—dependent upon the flexibility of the imagination, more perhaps than upon powers of observation. Few persons, however well trained, can look calmly and critically upon the phenomena. Fewer yet can, in the brief space of time, estimate the height of the body when first seen, or note such facts as may be of service in calculating its direction and rate of progress.

A peculiar feature of the case is the lack of ability on the part of an observer to locate the place of fall unless, indeed, he happens to actually see it strike the ground. This is due to several causes, and, in part at least, to the low angle at which the stones sometimes enter our atmosphere, which permits a continuation of flight for some distance, even miles, beyond the point at which they seemingly must strike the earth, and in part to the fact that one is unable to correctly estimate the distance, which may be much greater than supposed. No less an experienced student and collector than the late H. A. Ward once told the writer of his

experience in such matters. He was sitting in front of a house occupying a somewhat elevated position with reference to the rest of the town. Suddenly a meteorite appeared descending from the sky, and fell, he was sure, within a certain square on the lower level. He at once proceeded to the spot, only to find that he was mistaken but that it had fallen a "few blocks away." At this second point the same experience was repeated, and the stone finally located some twenty miles beyond the point where he was "certain" he had seen it strike.

An equally good illustration was offered in the flight of a meteorite over the city of Washington on Sunday, January 12, 1919. This was first called to my attention by a man some eighty miles south of Washington who saw it, as he assured me, strike the ground within one half a mile of where he was standing. Inasmuch as the meteorite had been observed passing over Washington in a northeasterly direction his statement was not accepted. Further reports of the fall in the immediate vicinity of the city and a few miles away were also received. Taking the direction along which the meteorite was traveling, I followed it up by correspondence for a distance of over 300 miles into northeast Pennsylvania where it became lost. The last reports received indicate that it was going in two directions at once (!) and it is very probable that it actually fell somewhere in that vicinity, nearly 400 miles from where first *seen* to fall.

Experiences similar to the above are common. In many other instances stones which were "seen to fall" have proved to be of strictly terrestrial origin. There comes a sudden flash and report, the observer goes quickly to the spot and there finding an object which had not previously attracted attention, assumes it to be a meteorite and in perfectly good faith writes some museum announcing his discovery and willingness to dispose of the same. There is probably not a museum of importance in the world that does not annually receive from one to many announcements of this kind. The receipt even of glacial boulders which were "warm when picked up" or "which set fire to the grass at the point where they fell" is not unusual.

This leads to the second point to which attention need be directed—that relating to the reported temperature of the fallen body, which is often to the effect that "it was too hot to touch," or has been the cause of fires. As in a great majority of cases it is impossible to investigate the actual temperature after the first report has been made it may be well for the moment to consider the probabilities.

While the original source from which meteorites are derived is problematical it yet seems certain that they have been wandering for an indefinite period in space and at a temperature of "absolute zero." At the time of entering our atmosphere it is fair to assume they are cold throughout to a degree of which we can have no conception. During the few seconds in which they are passing through our atmosphere, they become intensely heated on the immediate surface, but these portions are immediately stripped off, and, as we have absolute proof, the heat never extends to a distance of more than two or three millimeters. Before striking the ground the speed of the body is so far checked that it ceases to glow and the thin film of molten material quickly congeals. Cooling of the surface, owing to the intense cold of the interior, must follow rapidly and it is questionable in the writer's mind if a large majority of the reports of the heated condition of the meteorite when found are not based upon expectation rather than fact. He even goes so far as to suggest that when it shall become realized by the public at large that the chances are in favor of a meteoric stone being cold rather than hot when found, it will be so reported.

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ORIGIN OF SOIL COLLOIDS

Dr. Whitney[1] has advanced an interesting theory as regards the origin of soil colloids. He says, in part:

> My present view is that particles of matter derived from silicate rocks and other soil-forming minerals when they approach a diameter of .0001 mm. contain relatively so few molecules that the

[1] Science, 54: 656, 1921.

bombardment of the water molecules in which the particle is immersed shatters the particle beyond the ability of the molecules in the solid to hold together as a solid mass. The atoms of calcium, magnesium, potassium and sodium in the molecule of the silicate would go for the most part into true solution, while the atoms of silicon, aluminum, and iron would go chiefly into colloidal solution forming the basis of the colloidal matter or the ultra clay of the soil. It should be possible for the mathematical physical chemist, from physical constants now known, to determine empirically the relative size of the particle of matter which could withstand such bombardment without complete disintegration. This is a problem which has not yet been worked out.

This is one way of looking at their origin, but the results of our experimental work on soil colloids force us to adopt quite a different view. One that is not based on bombardment of water molecules, but one based largely on chemical reactions.

Many soil particles are hydrated silicates which contain varying amounts of aluminium, iron, silcon, sodium, potassium, calcium, magnesium and other elements in smaller quantities. Soil chemists claim that these particles are surrounded with a water-film, and that this film is held tenaciously. In the light of this the salts in the outer layer of these soil particles are subjected to constant hydrolysis. The hydrolytic products of the soluble compounds of sodium, potassium, etc., are partly taken up by this water film by way of solution, and part of them are adsorbed by the hydrolytic insoluble products of the iron and alumina salts which form a gel casing for the soil particle, that is, there is an equilibrium of the soluble salt between the water film and the insoluble gel which now surrounds the soil particle.

When the soil becomes flooded as after a rain, and the water moves down through the soil, the soluble salt of the water film is partly removed by diffusing into the moving water. This destroys the salt equilibrium between the water film and the incasing gel, and, hence, some of the soluble adsorbed salt is released to the water film. This continues until most of the soluble material is leached from the outer layer of the soil particle. This leaching may be continued until the incasing hydrolytic gel products of alumina and silica, and ferric oxide may pass into colloidal solution. Not only will the freedom of electrolytes tend to bring the incasing gel into colloidal solution but some of the soluble salts themselves or some salts that are moving through the soil under the proper hydrogen ion concentration will very much hasten their pepitization.

The pepitization of the hydrolytic insoluble compounds removes the encasing gel and the soil particle is again exposed to hydrolytic action, and in this way the weathering of the silicate particles proceeds. The pepitized gel or hydrosol moves through the soil, provided the pepitization is great enough, until it encounters a coagulating electrolyte or different hydrogen ion concentration, when it comes back as the gel and may be deposited on a soil particle, or come down as a precipitate where it remains as an adsorbent and reservoir for plant food until the conditions are sufficiently changed for it to pass back into the hydrosol; that is, the process is reversible

$$\text{hydrogel} \rightleftarrows \text{hydrosol}$$

and whether it is a hydrosol or a hydrogel depends on the soil environment.

Certain soil salts in our work have brought about a very beautiful pepitization, while other salts have brought about an equally definite coagulation. Then there are salts that lie in between these extremes. Again the same salts and same concentration have brought about both coagulation and pepitization by changing the hydrogen ion concentration.

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A CRAYFISH TRAP

IN ponds and streams where crayfish are abundant they can be readily taken by means of a trap constructed as follows: A rectangular box of any convenient size, sixteen by twenty-four inches for instance, is built of one-fourth inch mesh galvanized screen wire. Into one end of this box a removable funnel of like material is fitted. This funnel should project about eight inches into the box and have a flattened opening about four inches wide and an inch and a half deep. In setting the trap

it should be placed in shallow water on a sloping bank and partially embedded in the mud or sand so that the bottom of the funnel is even with the bottom of the pond. The rest of the trap extends out toward the deeper water. A dead fish wired securely to the bottom of the trap makes an excellent bait. Attracted by this bait, the crayfish crawl into the trap and seem to be unable to find their way back out. A single night-set with such a trap will reward the trapper with at least a water bucket full of crayfish for laboratory use, or for the more immediate purpose of supplying the camp with an exceedingly delectable breakfast.

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SPECIAL ARTICLES

NOTE ON THE RELATION BETWEEN THE PHOTIC STIMULUS AND THE RATE OF LOCOMOTION IN DROSOPHILA

IT is a fact demonstrated by many investigators that *Drosophila melanogaster* (ampelophila) is negatively geotropic and positively phototropic. In addition it is also known that light acts as a kinetic stimulus as well as a directive one. When the individual is illuminated, therefore, its movement is determined by the three factors operating simultaneously. If light acts in opposition to gravity the rate of upward crawling of the fly is lowered; and if light acts with gravity the rate is increased. Since the stimulus of gravity is always constant, and the photokinetic stimulus constant within wide limits, the rate of upward crawling is a measure of the effect of the phototropic stimulus.

Definite quantitative results have been obtained by measuring with a stop-watch the time necessary for wild flies to crawl to the top of a glass cylinder under three different intensities of light. Illuminated from above with a light of 1,500 candle meters the time taken for 50 per cent. of the experimental flies to reach the top (a distance of 172 mm) was found to be 6.17 seconds. With an intensity of 750 c.m., 7.6 seconds; and with an intensity of 75 c.m., 10.89 seconds. Each of these determinations is the average of 50 trials with 87 animals selected from five different cultures. The age of the flies varied between six and nine days. Under the illumination of a ruby lamp giving only enough light to enable observation, the time consumed in reaching the top was 11.3 seconds. There is then a definite relationship between the intensity of illumination and the rate of movement, which may be expressed by the Weber-Fechner law, as was done in the case of the Japanese beetle.[1] Figure 1 ex-

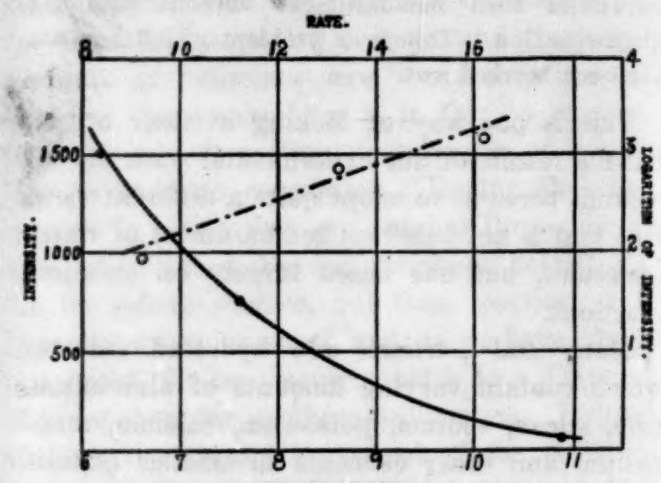

FIG. 1. Two graphs indicating the relation between light intensity and the phototropic orientation of *Drosophila*. The circles are points, at which Rate $= \frac{100}{\text{Reaction time in seconds}}$, plotted against the log of the intensity. The solid dots show the reaction time plotted against the intensity.

presses this relationship. The broken line is obtained by plotting the logarithm of the intensity against the rate of locomotion, where rate equals 100 divided by the reaction time in seconds. From this graph it may be concluded that the sensation is proportional to the logarithm of the intensity of the stimulus. The continuous line is obtained by plotting the reaction time in seconds against the intensity of light and leads to the same conclusion.

It was found by McEwen[2] that the mutants

[1] Moore, A. R., and Cole, W. H.: "The response of *Popillia japonica* to light and the Weber-Fechner law," *Jour. Gen. Physiol.*, 3: 331, January, 1921.

[2] McEwen, R. S.: "The reactions to light and to gravity in *Drosophila* and its mutants," *Jour. Exp. Zool.*, 25: 49, February, 1918.

of *Drosophila* known as *white* and *vestigial* show variations from the reactions of wild flies to light. He decided that the *vestigial* flies are not oriented by light, a conclusion apparently verified by experiments in which wild flies, whose wings had been removed, were used. The *white* race oriented positively to light, but with less regularity and precision. In my experiments it was also found that *white* flies are less precise in their photic orientation, it being many times impossible to secure satisfactory readings on 50 per cent. of the individuals, since after reaching the top of the cylinder some would crawl back to the bottom, even under an intensity of 1,500 c.m. No results, therefore, are presented for the *whites*. In the case of *vestigial* flies it was found that a mechanical factor retarded orientation. When the glass cylinder was used for these flies it was discovered that the reason they did not reach the top was because they continually lost their foothold, when part way up, and fell back to the bottom. This also happens with wild flies whose wings are normal, but immediately the wings are spread and the animal secures a new foothold very near where he was before. The upward movement is then continued, very little time having been lost. This difficulty with *vestigials* was removed by lining the cylinder with very thin Japanese rice paper. This may easily be done by moistening the paper, pressing it against the glass and allowing it to dry. With paper-lined cylinders the *vestigial* flies are strongly phototropic and reach the top in almost the same time as wild ones. The results are as follows: with illumination of 1,500 candle meters the time was 6.81 seconds; with 750 c.m., 7.92 seconds; and with 75 c.m., 11.1 seconds. In darkness the time for *vestigials* was 12.2 seconds. From this data it is evident that *vestigial Drosophila* is positively phototropic, the degree being only slightly less than in wild flies, as measured by the rate of locomotion. Some of this difference is undoubtedly due to the aid rendered by the flying of the wild individuals, although, as far as possible, all cases of extended flight were omitted from the averages.

It may be stated, therefore, that the effect of light on the locomotion of *Drosophila melanogaster* is related to the intensity of the photic stimulus according to the Weber-Fechner law, and secondly that the race of flies known as *vestigial* is positively phototropic, and may be demonstrated as such if the animals are given a rough surface on which to crawl.

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THE STRUCTURE OF BENZENE

THE writer has shown, in his thesis for the master's degree[1] and in an article soon to be published, that the benzene model first proposed by Körner,[2] and later advocated by Marsh,[3] Vaubel,[4] and others, interpreted in the light of the Lewis theory of the atom,[5] has a sound theoretical basis. By applying a theory of conjugation resembling in many respects that presented by Erlenmeyer, Jr., in 1901,[6] all objections to this benzene structure but one—that ortho and meta di-substitution products should, according to the theory, give stereoisomers which have not yet been resolved—have been removed.

In this model the six carbon tetrahedra have their bases all in the same plane, the hydrogen atoms and the points of the tetrahedra to which they are bonded being alternately above and below this plane. There are six electrons grouped around the center of each hexagon, and two at each of the hexagon corners and on the centerlines between each hydrogen and the carbon to which it is bonded.

In a paper written in October, 1920,[7] the

[1] Written in April, 1920; on file in the Library of the University of California.

[2] *Gaz. chim.*, 4: 444 (1874).

[3] *Phil. Mag.*, 26: 426 (1888).

[4] *J. prakt. Chem.*, [2] 44: 137 (1891); 49: 308 (1894); 50: 58 (1894. "Lehrbuch der theoretischen Chemie [J. Springer, Berlin, 1903],I, 468.

[5] *J. Am. Chem. Soc.*, 38: 762 (1916).

[6] *Ann.*, 316: 43, 71, 75 (1901).

[7] This paper was revised and submitted for publication in April, 1921. It is expected that it will soon be published.

author has shown that the structure of graphite, as determined by X-ray analysis,[8] is exactly what would be obtained if it were built of layers of benzene hexagons of the type just described, the carbon-hydrogen bonds of the benzene molecules being replaced by carbon-carbon bonds between the layers. Such an arrangement not only accounts for the symmetry of the substance and for the observed spectra, but also for its known chemical and physical properties.

There are quite a number of aromatic compounds, including benzene itself, in crystals of which, according to the author's conjugation theory, we might expect the molecules to be in layers of much the same type as the layers in graphite. Assuming this to be the case, if the densities, axial ratios and axial angles are known, the dimensions of the hexagon in these crystals can be calculated. This has been done for a considerable number of substances, and in every case in which large distortions would not be expected, due to substituted groups, *the dimensions of the hexagon are very close to the corresponding dimensions in graphite.* If this result were obtained for one or two crystals, it might be considered merely a coincidence, but it is found to be general; the dimensions are found to correspond best where least distortion would be expected; and the axial ratios and angles, and the crystal form, symmetry and cleavage, as well as the actual distances, are found to conform to the structures assumed. Hence *this structure for the benzene nucleus must be considered proved.*

This method of proof was reported on by the author in a paper presented at the twenty-fourth special meeting of the California Section of the American Chemical Society, held in conjunction with the annual meeting of the Pacific Division of the American Association for the Advancement of Science, at Berkeley, California, on August 5, 1921, at which time the structures of quinol, pyrocatechin and triphenyl carbinol were used as examples. The density of solid benzene was not then to be found in the literature. This is now obtainable, and from it and the axial ratios, by assuming close packing of the molecules in each layer, the hexagon dimensions can be computed. They again check with those in graphite.

A paper is now being prepared in which the method of proof and its application to a large number of aromatic compounds will be given in detail.

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[8] Debye and Scherrer, *Phys. Zeit.*, 17: 277 (1916); 18: 291 (1917); Hull, *Phys. Rev.*, 10: 661 (1917).

The author's interpretation of the experimental results is a compromise between that of Hull and that of Debye and Scherrer.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MEETING OF THE EXECUTIVE COMMITTEE OF THE COUNCIL

The spring meeting of the executive committee was held in the board room of the Cosmos Club, Washington, D. C., on April 23. It was called to order at 4:10, with Dr. Simon Flexner in the chair and with all members present, and it adjourned at 11:30, a recess of an hour and a half having been taken for dinner. The main items considered are shown below.

(1) Minutes of the last meeting (December 31, 1922), and of two actions taken by mail ballot in the interim were approved. These interim actions were (1) the formal vote to authorize the summer meeting with the Pacific Division, which is to occur on June 22-24, at Salt Lake City, and (2) the election of Dr. J. McK. Cattell to succeed himself as a member of the Board of Science Service.

(2) The permanent secretary presented a report on the affairs of the association for the half-year ending March 31. A summary of that report is appended to the report of this meeting.

(3) It was voted that all members of the American Medical Association who are not already members of the American Association for the Advancement of Science may become members of this association without the payment of the usual entrance fee ($5). The A. A. A. S. is unable each year to invite all

new members of the A. M. A. to join the more general association, as they have the privilege of doing according to the rules for affiliated societies of the A. A. A. S., and the special privilege is now made general to all members of the A. M. A., without reference to when they joined.

(4) It was voted that the permanent secretary should prepare an invitation letter to be sent (about October 1) to each member of the American Medical Association resident in New England, Iowa and Oregon, asking him to become a member of the American Association for the Advancement of Science if he is not already a member; these special invitations are to be signed by the president of the American Association for the Advancement of Science (Dr. J. Playfair McMurrich), the chairman of the Executive Committee of the Council (Dr. Simon Flexner), the permanent secretary and several others. It is planned that a special invitation of this kind shall be sent to other American Medical Association members resident in other regions next year, etc., the entire list of the Medical Association being cared for in perhaps four or five years.

(5) The budget for the current year was increased by the following items: Salaries, $180; printing, $520; summer meeting, $500.

(6) The permanent secretary was asked to secure good, readable reports of the meetings of all sections and of their related societies at the fourth Boston meeting, to have these published in SCIENCE about the last week of January, 1923, and to have this special issue of the journal sent to all members who do not receive SCIENCE regularly. The retiring president's address is to be published in the first issue of SCIENCE after the meeting, and reprints of this are to be made available, on request, to members who do not regularly receive the journal. It is planned that members in good standing who do not attend the annual meeting may receive copies of the general program, if they request them from the permanent secretary's office before the meeting.

(7) The making of arrangements for a speaker for one of the evening sessions of the summer meeting at Salt Lake City was referred to the general secretary with power.

(8) Dr. D. T. MacDougal reported that the committee on Cooperation with Mexican Men of Science recommends that Dr. E. L. Hewett, of the School of American Research, Santa Fé, N. M., be appointed special commissioner to consult with officials of the Mexican government regarding the organization of Mexican men of science. Dr. Hewett was appointed and was requested to serve the association in this capacity on his forthcoming trip to the City of Mexico. A committee consisting of Drs. Howard and MacDougal was instructed to prepare a suitable letter of credentials for the use of Dr. Hewett, this to be addressed to the Secretario de Agricultura y Fomento, to be engrossed, and to bear the seal of the association.

(9) It was voted that the expenses of the Committee on Grants be paid from the funds in charge of the permanent secretary.

(10) Dr. T. Wingate Todd, Western Reserve University, Cleveland, Ohio, was elected vice-president for Section H (Anthropology).

(11) Dr. Bird T. Baldwin, Iowa Child Welfare Research Station, State University of Iowa, Iowa City, was elected vice-president for Section Q (Education).

(12) The election of Dr. S. C. Prescott as chairman of the local committee for the fourth Boston meeting was ratified.

(13) Thirty-three members were elected to fellowship, on proper nominations.

(14) The resignation of Mr. Herbert A. Gill, auditor of the association, was accepted with regret, and with great appreciation of the very valuable services he has given the association in past years, and the permanent secretary was instructed to secure an auditor, preferably a well-known scientist, the clerical expense to be met by the permanent secretary's office.

(15) The Committee on Convocation Week was completed so that it is constituted as follows: Dr. J. McK. Cattell, Garrison-on-Hudson, N. Y., *chairman;* Dr. E. H. Moore, University of Chicago, Ill.; Dr. J. P. McMurrich, University of Toronto, Toronto, Canada; Dr. H. S. Jennings, Johns Hopkins University, Baltimore, Md.; and Dr. Edwin B. Wilson, Massachusetts Institute of Technology, Cambridge, Mass.

(16) The Canadian Society of Technical Agriculturists was constituted an affiliated soci-

ety of the association. Its officers are: *President,* Mr. L. S. Klinck, University of British Columbia, Vancouver, Canada; *secretary,* Mr. Fred H. Grindley, Gardenvale, P. Q., Canada.

(17) The Executive Committee reaffirmed the desirability of holding the 1925 meeting in Kansas City, and expressed its appreciative thanks to the persons and organizations from whom invitations to meet in that city have been received.

(18) The policy of Section N (Medical Sciences) was approved, by which it is planned that the program of this section, at the annual meeting, shall deal with such fields of work as parasitology, medical entomology, public health service, and others, where many medical scientists have common interests with those working in other fields of biology.

(19) A committee was appointed, consisting of the president, the general secretary and the permanent secretary, to arrange for the sending of delegates to the Hull meeting of the British Association for the Advancement of Science.

(20) The proposed federation of biological societies was considered at length, and the committee expressed itself as in sympathy with the general aims of the societies involved. The hope was expressed that the organization of the association may be of service to the new federation.

(21) The controversy aroused by recent popular publications regarding the theory of evolution was considered, and a committee of three was appointed to deal with this matter and make recommendations at the meeting of the executive committee. The committee on the evolution controversy consists of Dr. Edwin G. Conklin, Princeton University; Dr. C. B. Davenport, Station for Experimental Evolution; and Dr. Henry Fairfield Osborn, American Museum of Natural History, New York City.

(22) The permanent secretary was asked to secure manuscripts for the general program for the fourth Boston meeting as early as may be, to the end that the difficulties of publication may be obviated as far as possible.

(23) The section committee of Section Q (Education) was authorized to publish a separate section program for the fourth Boston meeting—the expense, not to exceed $25, to be met by the permanent secretary from current funds.

(24) The permanent secretary was authorized to provide suitable messenger service for the sessions of the biological societies meeting at Boston.

(25) It was voted that it is desirable for the association to secure a distinguished European scientist for an evening lecture at the fourth Boston meeting.

(26) The committee adjourned to meet in New York City (in the offices of the Science Press, by invitation of Dr. Cattell) on Saturday, October 21, 1922.

BURTON E. LIVINGSTON,
Permanent Secretary

PERMANENT SECRETARY'S REPORT FOR THE HALF-YEAR ENDING MARCH 31, 1922[1]

THE last volume of the Summarized Proceedings, published in October, 1921, is now nearly out of print. The total cost of publication was $6,744.16 and sales have amounted to $2,587.00, making the net cost, at the present accounting, $4,157.16. The volume is being sold to members for $2.00 and to others for $2.50. Fifty copies remain to be sold, besides twenty copies reserved for complete sets.—A booklet of information for prospective new members, which contains a statement of the organization and work of the association, was published in January. Copies may be secured from the permanent secretary's office.—The resolution regarding the United States Forest Service, adopted at the recent Toronto meeting, was printed as a leaflet and sent to all members of Congress and to other officials.

Invitations to join the association have been sent to 28,303 persons, of whom 830, or 3.4 per cent., have already joined. From September 30, 1921, to March 31, 1922, 1,111 new annual members and 9 new life members have been enrolled, and 22 members have been reinstated; the total gain was 1,142. During the same period 67 deaths were recorded, and 265

[1] Presented to the Executive Committee of the Council on April 23, 1922.

resignations, and 705 names were dropped (October 1) because of over two years of arrearage); the total loss was 1,037. Four members were transferred from annual to life membership. The net gain in total membership, for the half-year, is 105. The membership data for the last year and a half are tabulated below:

	Sept. 30, 1920	March 31, 1921	Sept. 30, 1921	March 31, 1922
No. of members in good standing..	10,002	9,637	10,160	9,911
Total enrollment..	11,442	11,524	11,547	11,652

It is clear that the membership is gradually increasing, but there still remain many persons in the United States and Canada who are vitally interested in scientific and educational progress but who are not yet enrolled in the association. Members of the association should do all in their power to increase the membership and thus strengthen the organization.

A local branch of the association was organized in the fall of 1921 and is in successful operation. This is the State College (Pennsylvania) Local Branch. Its officers are: *chairman,* A. J. Wood; *secretary,* J. Ben Hill. It has an enrollment of 53 members of the association. Fifteen new members have been secured through its activities. The State College Branch holds occasional meetings throughout the year.

Plans for the summer meeting of the association, jointly with the Pacific Division, which is to occur at Salt Lake City, June 22-24, 1922, are progressing satisfactorily. Details of these plans are in charge of Mr. W. W. Sargeant, Golden Gate Park, San Francisco, secretary of the Pacific Division, and the general secretary of the association, Dr. D. T. MacDougal, Carmel, California. The chairman of the local committee for the Salt Lake City meeting is Professor E. G. Titus, 215 S. Third East, Salt Lake City, Utah.

Card lists of all the members enrolled in each section of the association have been prepared and will soon be in the hands of the secretaries of the respective sections, together with a steel cabinet for each set of cards. These section lists will be kept continually corrected, by means of cards sent out from the permanent secretary's office. Each member's addressograph plate now shows, besides his name and address and the formula of his membership status, one, two, or three letters denoting the section or sections in which he is enrolled. Thus, ABD indicates that the member on whose plate this letter combination appears is enrolled in Sections A, B and D, and a corresponding card is found in each of the three section lists. When a member has indicated more than three sections as his preferences, the first three on his list have been indicated on the plate. In cases where no section has been named by a member, it has been impossible to enroll him in any particular section, and he is regarded as a member of the association in general. When members receive cards, etc., from the permanent secretary's office, they are requested to scrutinize the addressograph impression and inform the office if any corrections are needed with respect to their section enrollment.

Financially, the association is more than holding its own. The permanent secretary's reserve or emergency fund amounted (on March 31) to $5,855.09, $1,500 having been transferred to this fund on March 25. Of this, $1,000 is specially reserved from the current funds of 1922 for meeting the extra expense of publishing the next volume of Summarized Proceedings, which is to appear in the spring of 1925, following the next four-yearly (Washington) meeting. After all liabilities are cared for, over $2,000 is available (March 31, 1922) for appropriation from the current funds of the present fiscal year, which ends October 1, 1922.

SECTION M—ENGINEERING AND ASSOCIATED SOCIETIES

THE resuscitation of Section M at the recent Toronto meeting of the American Association for the Advancement of Science resulted in a program of considerable length and much diversity. The attendance was good, and the interest was sustained to the end. Sir Clifford Sifton, formerly chairman of the Commission of Conservation, Canada, gave the opening address on Tuesday afternoon, his subject being "Some Views on the Development of the Nat-

ural Resources of Canada." He dealt, among other things, with the fuel problems of Canada in their relation to the development of hydro-electric power, and with the general conditions obtaining at the present time in the rural districts.

Papers by Paul Heymans, now of the Massachusetts Institute of Technology, and Professor Charles Mannebeck, of the University of Louvain, Belgium, on "Optical Determination of Stress in Engineering Structures" and "Return Current along Submarine Cables," respectively, were read by the authors.

At the morning session on December 28, Mr. John Murphy, electrical engineer for the Department of Railways and Canals, Ottawa, gave an address on "Ice Formation and Prevention with Special Reference to Frazil and Anchor Ice." Mr. Murphy advocated keeping certain metal parts of hydro-electric installations a small fraction of a degree above 32°F. with the aid of artificial heat. This can be and is being done at certain plants on the Ottawa River to which Mr. Murphy made reference. "Engineering Standardization" was discussed by Mr. R. J. Durley, secretary of the Canadian Engineering Standards Association. Other papers were "Fifty Years of Progress in Mining in Canada" by Mr. John E. Hardman, "Metal Mining in Canada," by Thomas W. Gibson, deputy minister of mines, Ontario; "Gold Mining in Canada" by Mr. A. F. Brigham and "Nickel Mining and Smelting" by W. L. Dethloff, chief engineer of the Mond Nickel Company.

The morning session on Thursday, December 29, was given over to an illustrated address on "Toronto Harbor Development" by Mr. George Clark, chief designing engineer of the Toronto Harbor Commission, and to a discussion on Scientific and Industrial Research by Dr. R. A. Ross, chairman of the Honorary Advisory Council for Scientific and Industrial Research, Canada, who emphasized the economic importance of obtaining a satisfactory method of carbonizing the lignites of Western Canada. Mr. H. K. Wicksteed read a paper on "Railway Development in Canada" treating his subject chiefly from an economic standpoint. In the afternoon Messrs. A. M. McQueen and James McEvoy read papers on "Exploration for Oil in Western Canada" and "Coal Mining in Alberta" respectively. Sir Adam Beck, chairman of the Hydro-Electric Power Commission of Ontario, gave in Convocation Hall an address to all sections of the American Association for the Advancement of Science in the afternoon at 4 o'clock. This address was well attended and was illustrated by motion pictures. Sir Adam drew a comparison between the cost of Niagara generated hydro-electric energy in Windsor, Ont., and steam generated electric energy in Detroit, Mich., the prices being 3½ and 8 cents per kilowatt hour, respectively.

The Friday sessions, with the exception of Mr. D. B. Dowling's address on the Mackenzie oil fields, were given over to the discussion of problems pertaining to Engineering Education. Works Commissioner Harris, City of Toronto, gave the employer's viewpoint with respect to the qualifications of the young engineer. Professor Charles F. Scott, president of the Society for the Promotion of Engineering Education, contributed a paper on "Professional Engineering Education for the Industries." Dr. F. W. Merchant, director of industrial and technical education, Ontario, addressed the section on the function of the secondary technical school. Professor Dugald C. Jackson's paper on the same subject was read by Professor C. R. Young in the absence of the author. Discussion following all of these papers was very general.

Regarding the sessions of the Society for the Promotion of Engineering Education, held at Toronto on December 30, 1921, the reader is referred to the *Canadian Engineer,* Vol. 42, No. 1, p. 109, Jan. 3, 1922, and Vol. 12, No. 2, p. 133, Jan. 10, 1922.

The closing function was a dinner in Hart House on Friday evening at which one hundred were present. Mr. J. B. Tyrrell, chairman of the section, presided at all sessions. The committee in charge of arrangements consisted of the chairman, Mr. Tyrrell, and Professors R. W. Angus, Peter Gillespie and C. R. Young, all three of the University of Toronto.

Peter Gillespie,
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